

The Concept Of Aeronautical Adaptability As Developed By The U. S. Navy

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SUMMARY

Physicians working in the field of aviation medicine have known from the earliest days of the specialty that the psychological fitness of aviators was a critical element in minimizing aircraft accidents. Studies, spanning 8 decades of aviation, have demonstrated that the majority of aviation accidents have been the result of human factors. Selection of psychologically fit candidates and monitoring the status of designated Naval Aviation personnel has thus been one of the major tasks performed by Naval Flight Surgeons. To guide them, the concept of Aeronautical Adaptability has been developed. Composed of two similar but separate concepts, the first one requires the flight surgeon to evaluate the motivation, temperament, flexibility, and appropriate psychological defense mechanisms of aviation candidates. The second concept accepts that once designated, an aviator has proven his ability to adapt to the rigors of aviation. Still, it requires monitoring of the experienced aviator's pattern of coping with the stresses of aviation, and provides the means to find designated personnel Not Aeronautically Adaptable should maladaptive behavior affect the safety of flight. This paper will explore the early psychological standards in the U.S. Navy, then discuss Aeronautical Adaptability as it evolved over the last 15 years. It will discuss the rationale behind the current concept and show how Aeronautical Adaptability provides a fair, timely system of review to help the U.S. Naval Flight Surgeon process difficult cases that could present an unacceptable safety risk in Naval Aviation.

1. EARLY STANDARDS

Flight surgeons have faced the challenge of selecting qualified flight training candidates from military aviation's earliest days. Initial physical standards were simple, filling less than two pages (1). While any physical defect was grounds for rejection, physicians working in the field of aviation medicine

before World War One paid little attention to the psychological qualifications of the applicants. Flyers of that era were often "considered 'fools' and 'crazy' (2)." The 1912 directive from the Army Surgeon General on aviation selection made no mention of a candidate's personality or psychological status (3). Later that same year, the Navy largely copied the Army standards when creating Naval Circular Letter No. 125221 titled *Aviation Duty: Physical Examination of Candidates*. The only significant addition to the Army's directive, was a single line stating, "... any candidate whose condition shows that he is inclined to any excess that may disturb his mental balance or to alcoholism, should be rejected (1)." Applicants were accepted provided they had enough nerve and passed the newly developed aviation physical examination (4).

Early physical standards were stringent. Responding to reports from Great Britain that "Ninety of every 100 British aviators killed during this period died because of their own individual deficiencies and of these, 60 were found to have been directly due to physical defects (5)," American flight surgeons created physical standards to ensure that "no aviator shall fail in his mission because of discoverable physical defects (6)."

Not all believed such ideal standards were necessary. Assistant Surgeon R. P. Parsons was the first Navy physician to document his dissent. In April, 1918, Dr. Parsons wrote: "Our Navy has already rejected hundreds of applicants because of trivial minor defects, most of whom, it is safe to say, could have become successful aviators (7)." Troubled that too many of these "perfect health" men were unable to complete flight training, he became "convinced also that there is a *something else*, whatever it may be, worthy of investigation, and which should be deemed fully as important as a physical examination for use as a criterion by which men are to be selected or rejected in the recruitment of student aviators." By

questioning experienced flight instructors, he hoped to identify "the most essential qualities contributing to the making of a successful aviator." To a man, those surveyed identified: "(1) Coolness under strain; (2) Dependableness to always do the correct thing at a critical moment; (3) Mental and physical alertness; (4) Lack of any inherent fear of being in the air; and (5) Persistence and perseverance in his ambition" as the ingredients necessary "to become a successful aviator."

The instructors disagreed on whether "the temperamental type of extreme stolidity or that of great nervous energy" was the preferable personality style for the ideal student. Parsons devised 10 clinical tests to determine if the instructors' opinions were valid and predictive of a candidate's flying ability. Testing 250 students, he found 2 tests that he believed had some validity, 3 were of no use and insufficient data was available on the other 5. He concluded that more work was needed to standardize tests that could be used to supplement physical exams, thereby improving the efficiency of the selection process.

2. BEGINNING OF AERONAUTICAL ADAPTABILITY

It would appear that Parson's paper had little effect on the Navy. Standards published in 1922 by Neuberger cited the need to carefully select candidates, stressing the requirements of "mental attitude and physical fitness (8)." Totalling 28 pages, the report frequently mentioned that candidates be "mentally qualified", yet never defined what was mentally qualifying or disqualifying.

In 1927, troubled by the high cost of flight training, the Chief of the Bureau of Aeronautics sent a letter to the Commandant of the Pensacola Naval Air Station, pointing out that part of the expense was due to excessively high student failure rates (9). The Superintendent of Aviation Training turned to his flight surgeons for suggestions.

Lieutenant Commander Louis Iverson, MC, a member of the first Navy class to graduate from the Army School of Aviation Medicine, was already working on the problem. The previous year, Iverson and Lieutenant H. B. Crummes, MC, had implemented a routine method of evaluating the psychological fitness of candidates. Iverson would conduct the physical examination on each candidate, after which Crummes obtained their psychiatric history. Each medical officer would attempt to form a definitive opinion of a candidate's aptitude. Iverson and Crummes then met at the end of the day to discuss each cadet. After assigning a numerical grade predictive of his probable success or failure, the subject's progress in flight school was monitored.

From Iverson's and Crummes early work came the concept of Aeronautical Adaptability (AA). The 1927 edition of the Manual of the Medical Department was the first official Navy instruction to use the term:

Aeronautical adaptability. Graded from 0 to 4.0. When derogatory impressions are obtained they will be the subject of a confidential letter to the bureau, accompanying the forwarding of Form No. 1. If aeronautical adaptability is graded below 2.5 and if otherwise physically qualified the recommendation will read: "Physically qualified but not temperamentally adapted (10)."

Vague from the outset, the grading scale was designed to be compatible with the Navy's standard 4.0 evaluation system. Missing were criteria upon which to assign values, so flight surgeons used their judgment to grade candidates. AA became an integral part of the Naval Flight Surgeon lexicon in 1927, and has been a required determination on every flight physical, including "winged" personnel, since that time.

Iverson's report to the Bureau of Aeronautics focused attention on the problem. In 1928 Rhoades described the state of the selection process (11). Each candidate received an extensive physical exam, which was followed by a psychological evaluation, consisting of a review of the candidate's life to that point. Memory and reaction time were measured by a word reaction test very similar to one created by Parsons in 1918 (7). From the interview the flight surgeon was to place the candidate into one of three classes of personality characteristics – above average, average, or below average (Table 1). Aeronautical adaptability was the flight surgeon's "prognostication as to whether he will pass or fail the course" (11), taking into account physical, as well as, psychological fitness based on the preponderance of characteristics the candidate had in a given class.

Improvements were being made, but flight surgeons were still troubled by the selection process. Ilkstadt (12), in 1929, and Haselton (13), in 1930, stressed the need for more research into psychological factors. Ilkstadt compared success and failure rates in candidates whose physical findings were close to the limits for disqualification, as compared to students who approached the ideal. He concluded that "(1) *Within qualifying limits*, no correlation exists between physical findings and ability to fly; (2) Such physical findings were no indication of aeronautical adaptability; (3) The physical standards now required are not directed toward adaptability and neither increases nor decreases a student's chances to qualify as a pilot; and (4) Aeronautical Adaptability must be determined through neuropsychiatric examination (12)."

Haselton's article appeared in the very first edition of *The Journal of Aviation Medicine*, immediately preceding Longacre's classic article on pilots' personalities (14). Discussing the high percentage of failures in both Army and Navy flight training, Haselton believed that many of these failures were due to, "...the inability of the flight surgeon and medical examiner to determine the psychological equipment for flying of the applicants brought before him for examination (13)." He recognized that a candidate's temperament and personality were important factors in his ability to adjust to the aviation environment. He observed that extremes of either characteristic made success unlikely. Haselton also placed "tics, tremors, or the epileptoid diatheses" outside consideration of one's aeronautical adaptability, "as these are considered physical or psychiatric manifestations and should be divorced from the psychological examination (13)." Haselton was unaware that his opinion accurately predicted the form aeronautical adaptability would ultimately take 50 years later.

TABLE I. RHOADES' PERSONALITY CLASSES

Above Average	Average
Cheerful	Sober
Aggressive	Modest
Intelligent	Moderate intelligence
Precise	Moderate precision
Quick	Average
Retentive	Moderately retentive
Controlled	Moderately controlled
Attentive	Moderately attentive
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Below Average	
Depressed	
Submissive	
Stupid	
Vague	
Slow	
Not retentive	
Restless	
Inattentive	

3. AERONAUTICAL ADAPTABILITY OF THE 1930's

Responding to these reports, the Bureau of Medicine and Surgery sent Captain D.G. Sutton, MC, to Pensacola to analyze selection criteria (9). A psychiatrist, Sutton developed an extensive interview composed of psychiatric history, personality study, and psychological tests. In 1931 and 1933, Lieutenant C.G. De Foney, reported the results of two studies of 628 and 677 individuals respectively,

which Captain Sutton had initiated (15, 16). De Foney concluded that unstable individuals, which Sutton defined as the, "self-conscious, sensitive, introspective individuals with frank neurotic tendencies and the unstable extrovert with his unmistakable compensatory reaction of well-being (15)" should be eliminated from training. Positive predictive factors for success were stability, aggressiveness, and courage, while intelligence, concentration, and reaction time had little predictive value.

As a result of the efforts of Sutton, De Foney, and others, the 1937 Manual of the Medical Department definition of AA was changed to:

Aeronautical Adaptability: After the examination has been completed, the examiner shall make an assessment of the individual's qualifications for flying, based upon the physical findings and the result of the neuropsychiatric examination. While no individual will possess all good traits, or all bad ones, the examiner will summarize his impressions of the individual's aeronautical adaptability, which shall be recorded as favorable or unfavorable. Where an individual is found to be physically qualified but his aeronautical adaptability is regarded as unfavorable, the entry of findings on NMSAv-Form 1, as finally recorded, shall be "Physically qualified, but not aeronautically adapted." (17)

Following De Foney's work, others sought methods to predict a candidate's future success. One of the more interesting attempts of the 1930's was the use of the Schneider Index as a selection criteria. Developed by Dr. Edward C. Schneider in 1920 (18), this cardiovascular rating was used extensively by both the military and Civil Aeronautics Administration to detect chronic fatigue and exhaustion in aviators. The Army reported 106 applicant disqualifications in 1936 for failure to achieve adequate scores (19). In 1938, Lieutenant (Junior Grade) W. O. Fowler, MC, reviewed 1,021 consecutive records of Naval Aviation Cadets at Pensacola, comparing their Schneider score and success in flight training. He concluded, "In general, there is no correlation between the Schneider Index and a person's ability to fly (20)."

Along more traditional lines, Lieutenant Commanders R. H. White, MC, and V. S. Armstrong, MC, continued to define traits that were predictive of success or failure (9). Factors they correlated with success were strong motivation to fly, graduation from college, and good judgment. Failure was predicted in those indifferent to aviation, those with no education beyond grade school, or those with evidence, by history or examination, of emotional instability (21).

In 1939, the Civil Aeronautics Administration asked the National Research Council to form a committee to research the process of selecting aviators (22). The Navy was represented on the Committee on Selection and Training of Aircraft Pilots from its inception (9). As early as 1940, the Navy started screening Naval Aviation Cadets with early forms of the pencil and paper psychological tests developed by the Committee. In December 1941, of more than 40 tests tried, 3 were validated sufficiently to allow them to be put them into service screening all candidates (23). The Navy's current Aviation Selection Test Battery (ASTB) are direct descendants of these tests developed 50 years ago. For the Flight Surgeon, the ASTB is but another data point in determining a candidate's AA.

4. AERONAUTICAL ADAPTABILITY EVOLVES

Unlike the Adaptability Rating for Military Aeronautics (ARMA) used by the Army or Air Force (24), the Navy's AA assessment has not been restricted to candidates alone. Designated aviators require a determination of their aeronautical adaptability each time a flight surgeon issues them an "upchit", be it following an annual flight physical, or after medical grounding. What then of AA as it applied to aviators of the 1940's and 50's?

Commander E. L. Caveny, MC, in a discussion of the Naval School of Aviation Medicine's psychiatry curriculum, pointed out that neuropsychiatric conditions seen most often in aviators were such things as, "psychoneuroses, inadequate or defective personalities, borderline psychopathic states, and psychological disorders of all kinds (25)." Caveny said,

"Aviation Psychiatry is centered around those individuals who are by no means adequately adjusted, but who have no standing in the ranks of diagnoses, because the characteristics of some mental disorder are only partially developed..."

His thoughts on designated aviators were:

"They have proven themselves to be the stablest of the stable. They comprise a non-neurotic group, and there will be found amongst them relatively few predispositional factors tending toward a latent psycho-neurotic manifestation. This does not mean, however, that those who are inadequately adjusted, those who have borderline psychopathic personalities, and those having other conditions that have no standing in the ranks of diagnosis, have been eliminated, or are not present in this group."

While ill-defined, the concept of aeronautical adaptability allowed aviators with equally ill-defined conditions to be removed from flying duties based on the flight surgeon's recommendation. The opinions expressed by Caveny appear to have been the prevailing ones in Naval Aviation. In the 40 years between 1937 and 1977 the definition was largely unchanged. Each succeeding edition of the Manual of the Medical Department defined AA as had the previous one.

5. RECENT REVISIONS

Beginning in 1977, Captain P. F. O'Connell, MC, while head of the Psychiatry Department at the Naval Aerospace Medical Institute, began the first efforts to redefine the concept. Problems had arisen with candidates and designated personnel alike, who challenged the concept after being declared not aeronautically adaptable (NAA). The increased tendency of individuals to seek reversal of medical decisions through administrative channels, or the courts, forced reevaluation for AA's validity.

Using the Diagnostic and Statistical Manual-III of the American Psychiatric Association (1980) as a guide, he was able to define AA in terms of an individual's personality traits. As noted above, the original concept called for determination of AA based on "the physical findings and the result of the neuropsychiatric examination (17)." O'Connell proposed defining all diagnosable diseases as to their effects on a individual's physical qualification (26). Conditions such as fear of flying, airsickness, personality traits / disorders that might interfere with the safety of flight would be evaluated as to how they impacted a person's aeronautical adaptability.

Psychiatric diseases found on Axis I would be physically disqualifying. Axis II conditions such as personality disorders, or personality traits that might significantly interfere with safe flying would disqualify the individual as not aeronautically adapted. The impact of the individual's personality style on their ability to safely operate in the aviation environment would be the basis for a determination of AA verse NAA. Issues of lack of motivation should be handled through administrative channels.

In 1987, the concept was refined further and presented to NAMI's Aeromedical Advisory Council for inclusion in the next revision of the Manual of the Medical Department (27). While O'Connell focused on AA as it applied to designated personnel, candidates weren't specifically addressed. Two separate but similar versions of AA were therefore presented.

For candidates the term used was Aeronautically *Adaptable*:

"Candidates or students must demonstrate reasonable perceptual, cognitive, and psychomotor skills on the AQT/FAR (officer applicants only) and must have the potential to adapt to the rigors of aviation by possessing the temperament, flexibility, and mature defense mechanisms to allow full attention to flight and successful completion of training. Before selection, candidates are to be interviewed by the flight surgeon for evidence of early interest in aviation, motivation to fly, absence of motion sickness, and practical appreciation of flight beyond childhood fantasy. Evidence of positive coping skills and good interpersonal relationships should be thoroughly evaluated (28)."

Completing flight school was considered proof of an individual's ability to adapt to the aviation environment. Designated aviators were therefore considered Aeronautically *Adapted*:

"Those having demonstrated the ability to utilize long term appropriate defense mechanism and displaying the temperament and personality traits necessary to maintain a compatible mood, suppress anxiety, and devote full attention to flight safety and mission completion (28)."

DSM-III significantly changed the way Naval Flight Surgeons approached the problem of defining aeronautical adaptability. Prior to its publication, the focus of the Navy's selection process was to identify traits predictive of a candidate's success. Longacre's classic study provided a list of favorable traits that an aviator might possess, and led to creation of the ARMA, still used by the U. S. Army and Air Force to select candidates (24). Navy, Army, and Air Force researchers have tried for years to divine the magic combination of physical, psychological, and personality traits that would guarantee success in military aviation. The trouble with that approach is that the requisite characteristics of the ideal aviator have long been elusive.

Under the Navy's current concept, during the initial physical examination flight surgeons strive to identify characteristics that would prevent a candidate from completing training. This model assumes that a properly motivated candidate, possessing normal temperament, flexibility and defense mechanisms will be able to suppress any anxiety associated with flight training, and devote his/her full energies to completing the program (28). It should be noted that few Student Naval Aviators (SNA) would be able to discuss the concept of suppression as a defense mechanism for flight

related anxiety, yet they are taught early in their flying career of the need to leaving distracting issues on the ground by focusing on the task at hand or "compartmentalizing".

Should the individual's psychological defense mechanisms prove inadequate to deal with the stresses of flight training, the model predicts that dysfunctional behavioral patterns will appear. These patterns include poor performance, training difficulties, poor stress coping, flight anxiety, difficulty with crew coordination and/or interpersonal relationships, or an inability to deal with the normal stresses of life. Students exhibiting such behaviors invariably present to sickcall, either through self-referral or when directed by their instructor. Evaluation follows the cookbook approach of DSM-III-R (29). An Axis I diagnosis would result in either temporary or permanent physical disqualification (NPQ), depending on the prognosis. Axis II Personality Disorders or maladaptive personality traits that preclude continued satisfactory performance in the aviation environment, even though short of meeting the criteria for a disorder, would lead to disqualification as not aeronautically adaptable (NAA).

The model for designated aviators makes the same assumption that Caveny made in 1945 when he described fleet aviators as: "the stablest of the stable (25)." Those aviators presenting with situational stress, anxiety, poor coping, or other problems of a perceived psychological / psychiatric nature would initially be NPQ pending appropriate evaluation.

An aviator with an Axis I diagnosis would be treated as is a candidate with a similar diagnosis, except the potential for the designated aviator to receive a waiver is greater (30). An aviator with an Axis II diagnosis is more difficult to deal with. Rarely is an individual with a true personality disorder able to complete flight training given the stress levels involved. A few do. What challenges the flight surgeon then is deciding if the pattern of maladaptive behavior is chronic, and if it interferes with safety of flight, crew coordination, or mission completion. Given the large investment the Navy has made in training an aviator, all cases involving designated individuals must be referred to NAMI's Department of Psychiatry for evaluation (28).

Motivation, performance and technical ability have yet to be mentioned. Under the current concept, designated personnel whose motivation, aviation skills, attitude, or flight safety record are found wanting are referred to an administrative board to determine their fitness to continue in aviation. Medical opinions regarding whether an individual is PQ / NPQ and AA / NAA are considered by the

board, but are not a bar to administrative action even if they are diagnosed as NPQ or NAA.

6. SUMMARY

It is interesting to note that the Army's and the Navy's psychological standards developed along parallel but largely separate courses. That is not surprising when one considers that during the period of 1919-1926 and again in 1936-1939, 56 of the first Naval Flight Surgeons trained alongside their Army counterparts at the Army School of Aviation Medicine (31). Still service differences existed then and persist today. The Army and the Air Force currently use the Adaptability Rating for Military Aeronautics (ARMA) to guide in the selection of candidates (24). The Navy uses a similar concept termed Aeronautical Adaptability (AA), which is broader in scope as it applies to both candidates and designated aviators each time the flight surgeon interacts with them.

Advantages the Navy's concept of Aeronautical Adaptability offers include:

- (1) Model directly correlates with DSM-III-R and Secretary of the Navy nomenclature separating physical and nonphysical disorders.
- (2) Provides a method of disqualifying individuals based on their impact on safety of flight.
- (3) Uses established criteria to categorize behavior, helping to standardize results.
- (4) Provides a fair system of review of potentially controversial cases.
- (5) It is easy for Student Naval Flight Surgeons to conceptualize.
- (6) It uses terminology that has been in place for over 60 years – it is accepted and it works.

References

1. Stokes, C. F., "Aviation Duty: Physical Examination of Candidates", Circular Letter No. 125221, Bureau of Medicine and Surgery, October 8, 1912.
2. Ceres, F., "Aviation Medicine in the United States Navy", *War Medicine*, 1, 1941, pp 43-49.
3. Jones, D. R. and Perrien, J. L., Chapter 17, "Neuropsychiatry in Aerospace Medicine", In: DeHart, R. L., "Fundamentals of Aerospace Medicine", Philadelphia, Lea & Febiger, 1985 (ISBN 0-8121-0880-9), pp 538-570.
4. Benford, B., "Doctors in the Sky", *Aviation, Space, and Environmental Medicine*, 55, 7, July 1984, pp 674.
5. Armstrong, H. G., "Aerospace Medicine", Baltimore, Williams & Wilkins Company, 1961, pp 90.
6. Air Service Medical, Washington, Government Printing Office, 1919, pp 20.
7. Parson, R. P., "A Search for Nonphysical Standards for Naval Aviators", *U. S. Naval Medical Bulletin*, XII, 2, April 1918, pp 155-172.
8. Neuberger, J. F., "Aviation Medicine in the United States Navy", *U. S. Naval Medical Bulletin*, XVI, 6, 1922, pp 983-1011.
9. Kellum, W. E., "An Early Attempt to Evaluate Psychological Fitness for Flight Training", *Contact*, 6, 4, January 1948, pp 232-235.
10. Manual of the Medical Department of the United States Navy, Washington, Government Printing Office, 1927, pp 196.
11. Rhoades, G. C., "Examination of Candidates for Aviation Training", *U. S. Naval Medical Bulletin*, XXVI, 1, January 1928, pp 502-517.
12. Ilkstadt, A., "Physical Qualifications and Aeronautical Adaptability", *U. S. Naval Medical Bulletin*, XXVII, 1, January 1928, pp 9-16.
13. Haselton, F. R., "Psychological Considerations in Judging Aeronautical Adaptability", *Journal of Aviation Medicine*, I, 1, pp 29-32.
14. Longacre, R. F., "Personality Study", *Journal of Aviation Medicine*, I, 1, pp 33-50.
15. De Foney, C. G., "A Psychological Study Made on Candidates for Aviation Training", *U. S. Naval Medical Bulletin*, XXIX, 2, April 1931, pp 191-204.
16. De Foney, C. G., "A Second Psychological Study Made on Candidates for Aviation Training", *U. S. Naval Medical Bulletin*, XXXI, 2, April 1933, pp 103-111.
17. Manual of the Medical Department of the United States Navy, Washington, Government Printing Office, 1937, pp 172.

18. Schneider, E. C., "A Cardiovascular Rating As A Measure of Physical Fatigue and Efficiency", *Journal of the American Medical Association*, 74, 1920, pp 1507-1510.
19. Dille, J. R., "Classics in Aerospace Medicine: Commentary", *Aviation, Space, and Environmental Medicine*, 61, 3, March 1990, pp 281.
20. Fowler, W. O., "A Statistical Survey of the Schneider Index and Its Relationship to Flying Training", *Journal of Aviation Medicine*, 9, June 1938, pp 114-119.
21. Bigelow, R. B., "Psychiatric Problems in Military Aviation", *War Medicine*, 2, 3, May 1942, pp 381-402.
22. "Aviation Psychology", *BUMED Newsletter, Aviation Supplement*, 1, 2, October 1943, pp 2-3.
23. "The Use of Tests in Selecting Naval Aviators", *BUMED Newsletter, Aviation Supplement*, 1, 4, October 1943, pp 1-2.
24. Mills, J. G. and Jones, D. R., "The Adaptability Rating for Military Aeronautics: An Historical Perspective of a Continuing Problem", *Aviation, Space and Environmental Medicine*, 55, 6, June 1984, pp 558-562.
25. Caveny, E. L., "Aviation Psychiatry", *Contact*, 4, 4, May 1945. pp 382-389.
26. O'Connell, P. F., "Aeronautical Adaptability???", *Society of U. S. Naval Flight Surgeons Newsletter*, May 1981, pp 1-4.
27. Baggett, J. C., "Aeronautical Adaptability", *Society of U. S. Naval Flight Surgeons Newsletter*, January 1988, pp 2-4.
28. "Aviation Psychiatry", *U. S. Navy Flight Surgeon Manual*, Washington, Government Printing Office, 1991, pp 6-1 to 6-12.
29. American Psychiatric Association: "Diagnostic and Statistical Manual of Mental Disorders, 3rd Ed. revised", American Psychiatric Association, Washington, 1987.
30. Bailey, D. A., Gilleran, L., Merchant, P. G., "The Waiver Process and Disqualifying Medical Conditions in U. S. Naval Aviation Personnel", In Press.
31. "Aviation Psychiatry", *U. S. Navy Flight Surgeon Manual*, Washington, Government Printing Office, 1968, pp 100-104.